

The Genus *Callistochiton* Dall, 1879
(Mollusca : Polyplacophora)
in the Eastern Pacific, with the Description of a New Species

BY

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(3 Plates; 9 Text figures)

THE GENUS *Callistochiton* Dall, 1879, is particularly well represented in the eastern Pacific. Ten species are recognized here, 4 in the north temperate region (one new to science), 5 in the tropical region, and 1 in the south temperate region, distributed between 40°N and 20°S. The genus has representatives worldwide, mostly in the tropical belt, but nowhere with the abundance with which it is found on the west coast of the American continent.

The purpose of this paper is to review the taxonomic position of the eastern Pacific chiton species assigned to the genus *Callistochiton* and ascertain their currently known ranges of distribution. The work is based upon the chiton collections in the California Academy of Sciences (CAS), Natural History Museum of Los Angeles County (LACM), Allan Hancock Foundation (AHF), National Museum of Natural History (USNM), Academy of Natural Sciences of Philadelphia (ANSP), University of California at Los Angeles (UCLA), San Diego Museum of Natural History (SDNH), American Museum of Natural History (AMNH), British Museum (Natural History) (BMNH), and the private collections of Glenn & Laura Burhardt, Salle Crittenden, George A. Hanselman, Allyn G. Smith (AGS), and Antonio J. Ferreira (AJF).

POLYPLACOPHORA de Blainville, 1816

Neoloricata Bergenhayn, 1955

ISCHNOCHITONINA Bergenhayn, 1930

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CALLISTOPLACIDAE Pilsbry, 1893

Callistochiton Dall, 1879

Tegmentum conspicuously sculptured; end valves and lateral areas of intermediate valves with strong radial ribs which, on closer examination, often appear as undulations rather than thickenings of the tegmentum; these "ribs" are often granose or tuberculated. Characteristically, the lateral areas are bicostate, and the end valves have no more than 10-12 ribs. The central areas of the intermediate valves are usually strongly sculptured, too, with longitudinal riblets, latticing, or a pitted appearance. The insertion plates tend to be relatively short; the insertion teeth are often thickened at the edges of the slits and festooned at the free edges. The slits tend to correspond in number and position to the ribs of the tegmentum. The intermediate valves are uni-slitted. The sutural laminae are relatively short, subquadrate to semi-oval; sinus relatively shallow. Girdle narrow, densely set with relatively small, imbricating scales. Gills as long as the foot.

Type species: *Callistochiton palmulatus* Dall, 1879, by M

Remarks: Many workers consider "Carpenter in Dall" as the proper authority for *Callistochiton*. Unquestionably, *Callistochiton* was Carpenter's manuscript name and arrangements as revealed not only by DALL (1879), TRYON (1883), and PILSBRY (1893), but through the examination of the relevant pages in Carpenter's unpublished manuscript in the repository of the National Museum of Natural History, Washington, D. C., made available to me through the kindness of Dr. Joseph Rosewater. But

since names proposed in unpublished manuscripts have no taxonomic standing, the fact remains that it was DALL (1879), who adopted and first published the name *Callistochiton*, defining the genus with the description and figure of the radula of *C. palmulatus*. Thus, there seems to be no justification for the dual authorship "Carpenter in Dall," often given to *Callistochiton*. It must be added that the case of *Callistochiton* differs from those where the second author gives the first author's description, or illustration, or both; for instance, in several species with the authorship "Carpenter in Pilsbry," such as *Lepidozonia sinudentata*, the dual authorship is appropriate inasmuch as Pilsbry quotes directly from Carpenter's unpublished manuscript in a manner which makes it clear where Carpenter's contribution ends and Pilsbry's begins.

THIELE (1929: 18) placed *Callistochiton* as a subgenus in *Lorica* H. & A. Adams, 1852 (together with *Lorica s. s. Lepidozonia* Pilsbry 1892, *Loricella* Pilsbry, 1892, and *Squamophora* Nierstraß, 1905), apparently on the basis of radular characteristics. This taxonomic arrangement has had no acceptance among chiton workers (FERREIRA, 1974).

Synonyms: *Lophochiton* Ashby, 1923 [not Berry, 1925], (Type: *Lophochiton johnstoni* Ashby, 1923, by OD); *Callistassecla* Iredale & Hull, 1925 (Type: *Callistochiton mawlei* Iredale & May, 1916, by OD); *Callistelasma* Iredale & Hull, 1925 (Type: *Chiton antiquus* Reeve, 1847, by OD).

Callistochiton palmulatus Dall, 1879

(Figure 1)

"*Callistochiton palmulatus* Cpr." DALL, 1879: 297; fig. 20 (radula)

Callistochiton palmulatus. HADDON, 1886: 20 - THIELE, 1893: 378; plt. 31, fig. 8 (radula) - PILSBRY, 1893, 14: 262 to 264; plt. 58, figs. 7-16 - BERRY, 1907: 52 - E. P. CHACE, 1917: 30 (Pleistocene) - DALL, 1921: 193 - JOHNSON & SNOOK, 1927: 564-565; fig. 663 - OLDROYD, 1927: 894 - T. A. BURCH, 1942: 7 - J. Q. BURCH & T. A. BURCH, 1943: 5, 7 - PALMER, 1945: 101 - A. G. SMITH, 1947: 18 - A. G. SMITH & GORDON, 1948: 208 - LELOUP, 1953: 17-18; fig. 11 (with syn. *Callistochiton palmulatus mirabilis* Pilsbry, 1893) - LIGHT'S Manual, 2nd ed., 1954: 217-218 - PALMER, 1958: 279; plt. 32, fig. 1 - G. & L. BURGHARDT, 1969: 12; plt. 1; figs. 7, 8 (with syn. *Callistochiton acinatus* Dall, 1919, and *C. celetus* Dall, 1919) - McLEAN, 1969: 63-64; fig. 35.4 - A. G. SMITH in Light's Manual, 3rd ed., 1974: 463, 464 - ABBOTT, 1974: 399 - A. G. SMITH, 1977: 217, 239-240

(with syn. *Callistochiton acinatus* Dall, 1919, *C. celetus* Dall, 1919, and *C. connellyi* Willett, 1937)

Callistochiton palmulatus mirabilis PILSBRY, 1893, 14: 263 to 264; plt. 58, figs. 7-11; 1898: 288 - BERRY, 1907: 52 - CHACE, 1917: 30 (Pleistocene) - DALL, 1921: 194 - BERRY, 1922: 409-412, 415, 489-492; tbl. 1; text fig. 11; plt. 14, figs. 9-16; plt. 15, figs. 1-14 (Pleistocene); 1926: 456 (Pleistocene) - OLDROYD, 1927: 894-895 - J. Q. & T. A. BURCH, 1943: 5 - A. G. SMITH, 1947: 18 - A. G. SMITH & GORDON, 1948: 208 - LELOUP, 1953: 17-18; fig. 11 (syn. of *C. palmulatus*) - LIGHT'S Manual, 2nd ed., 1954: 218 - A. G. SMITH, 1963: 148 - G. & L. BURGHARDT, 1969: 12 - A. G. SMITH in Light's Manual, 3rd ed., 1974: 464

Callistochiton acinatus DALL, 1919: 510; 1921: 194 - OLDROYD, 1927: 898 - A. G. SMITH, 1947: 18 - G. & L. BURGHARDT, 1969: 12 (syn. of *C. palmulatus*) - ABBOTT, 1974: 399 - A. G. SMITH, 1977: 217, 239 (syn. of *C. palmulatus*)

Callistochiton celetus DALL, 1919: 510-511; 1921: 194 - OLDROYD, 1927: 898 - A. G. SMITH, 1947: 18 - G. & L. BURGHARDT, 1969: 12 (syn. of *C. palmulatus*) - ABBOTT, 1974: 399 - A. G. SMITH, 1977: 217, 239 (syn. of *C. palmulatus*)

Callistochiton connellyi WILLETT, 1937: 25-26; plt. 2 fig. 13 - A. G. SMITH, 1947: 18 - A. G. SMITH & GORDON, 1948: 208 - G. & L. BURGHARDT, 1969: 11; plt. 1, fig. 4 - ABBOTT, 1974: 399 - A. G. SMITH, 1977: 217, 240 (syn. of *C. palmulatus*)

Description: Chitons with high-arched, rounded back. Length up to 1.5 cm. Color light creamy, often with greenish to gray specks. Anterior valve with 9-11 massive, somewhat pustulose, radial ribs. Posterior valve often raised and thickened by the presence of 4 to 6 unusually strong radial ribs; mucro anterior. Lateral areas of intermediate valves robustly bicostate. Central areas with some 15 longitudinal riblets per side, finely cross-ribbed. In the end valves, the sulci between the radial ribs are wide and coarsely pitted; similarly, pitted sulci separate the radial ribs in the lateral areas. Girdle often banded and covered with closely set, imbricating, oval scales about 150 μ m in length, with some 10-12 deep striations (Figure 1). Articulamentum white. Valves thick and massive. Sutural laminae semioval, sharp; sinus hardly formed, almost absent in the posterior valves. Insertion teeth short; in valve i there are 9-11 teeth, somewhat thickened at the edge of the slits, corresponding in position to the radial ribs of tegmentum; intermediate valves unslitted; posterior valve conspicuously thick, with a close series of small, irregularly shaped teeth, about 20 in number.

The radula is figured in DALL (1879: fig. 20), and THIELE (1893: plt. 31, fig. 8). Dall's description of the

major lateral as having "a simple cusp" (DALL, *op. cit.*: 297) is not correct; as Thiele's illustration shows, there are 2 cusps, a large inner cusp, and a small outer one. The examination of the radulae of 6 specimens of *Callistochiton palmulatus* from several localities corroborated the anatomical details shown in Thiele's figure; Dall's figure is compatible with Thiele's and my own observations except for the description of the cusp of the major lateral. However, the difficulties of correctly observing the radula, particularly if the specimen happens to be small, may easily explain the discrepancy; in addition, if viewed from the side the cusp may look single and simple, as Dall illustrated and described. A specimen of *C. palmulatus* (Monterey Bay, California, leg. A. J. Ferreira, at 20m, June 30, 1977, AJF 342), measuring 16.2 mm in length, has a radula 6.3 mm long, *i. e.*, 39% of the specimen's length with 40 rows of mature teeth. The median tooth is 135 μ m long, enlarged anteriorly where it bears a thin blade about 95 μ m wide. First lateral has the characteristic knob in the outer-anterior corner. The major lateral is bicuspid, the larger inner cusp measuring 125 μ m in length. Outer marginal teeth are elongated, measure 115 μ m in length, 75 μ m in width.

Type Material: Dall limited himself to a description of the radula; his material could not be located either at the National Museum of Natural History, or at the Academy of Natural Sciences of Philadelphia, and is presumed lost. The first complete description of the species comes from PILSBRY (1893: 14: 262-263) based on Carpenter's manuscript description, drawings and specimens. The description corresponds to a specimen in the Carpenter Collection in the Redpath Museum, Canada, bearing the label "type, Sta. Barbara, Cooper no. 1077" (*vide* PALMER, 1958: 279). The specimen is regarded as a holotype by PALMER (*loc. cit.*). Since the author of *Callistochiton palmulatus* is Dall, not Carpenter, Palmer's designation under the present rules of the ICZN is incorrect; the radula, or, rather the specimen from which the radula was obtained, that served Dall as the basis for his "description," would be the holotype. In the interest of the stability of nomenclature and fixation of the concept of the species *C. palmulatus*, the specimen illustrated by PALMER (*op. cit.*: pl. 32, fig. 1), and described in PILSBRY (*op. cit.*: 262-263) is herein designated as a neotype. The specimen, as stated by PALMER (*op. cit.*: 279) measures 8 mm in length and 7 mm in width; it is preserved dry, with valves i, vii, and vii separated, as Redpath Museum no. 48.

Callistochiton palmulatus mirabilis Pilsbry, 1893: syntypes (ANSP 118682): type locality, San Diego, California.

Callistochiton acinatus Dall, 1919: holotype (USNM 218733); type locality, San Pedro, California.

Callistochiton celetus Dall, 1919: lectotype and paralectotype (USNM 218770); type locality, San Pedro, California.

Callistochiton connellyi Willett, 1937: holotype (LACM 1048), and several paratypes; type locality, "Arbolito Point, near Ensenada, Lower California, Mexico."

Type Locality: The locality of Dall's original specimen is unknown. The locality of the neotype specimen, as given by PILSBRY (1893) and PALMER (1958) is Santa Barbara [34°25'N, 119°42'W], Santa Barbara County, California.

Distribution: Seemingly continuous between parallels 39° N and 27° N. The northernmost record is Buckhorn Creek [39°17'N, 123°48'W], Mendocino County, California (CASG 32233). The southernmost record is San Pablo Point [27°12'N, 114°29'W], Baja California, Mexico (LACM 71-178). The species has been collected at most offshore islands, namely Santa Rosa (LACM-AHF 1282-41), Santa Cruz (LACM 96-32), Anacapa (LACM AHF 1421-41), Catalina (LACM 64-26), San Nicolas (LACM-AHF 1694-49), San Clemente (LACM-AHF 66-51), Coronados (LACM 63-41), Natividad (LACM 72-116), San Gerónimo (LACM 71-91), San Martin (LACM-AHF 1694-49), Guadalupe (CASG 32746), and Cedros (LACM 72-115). Known bathymetric range extends from the intertidal zone to 40-50 fathoms [73-82 m] (LACM-AHF 1297-41).

Fossil Record: Pleistocene deposits in southern California (CHACE, 1917; BERRY, 1922), in San Quintín, Lower California, Mexico (BERRY, 1926) and in Guadalupe Island (FERREIRA, 1978a).

Remarks: The subspecies *Callistochiton palmulatus mirabilis* Pilsbry, 1893, is suppressed here as a synonym, as already suggested by LELOUP (1953: 17-18). The observation of many intergradations between the 2 morphs "*palmulatus*" *s. s.* and "*mirabilis*," and their total lack of correlation to locality or depth demonstrate that the forms of tail valve and mucro represent intraspecific variation with no taxonomic significance. *Callistochiton acinatus* Dall, 1919 and *C. celetus* Dall, 1919 were found to be synonyms of *C. palmulatus* upon examination of the respective type material (A. G. SMITH, 1977: 239). The synonymy of *C. connellyi* Willett, 1937, already indicated by A. G. SMITH (*op. cit.*: 240), was reaffirmed upon examination of the holotype through the courtesy of Dr. James H. McLean.

Callistochiton crassicosatus Pilsbry, 1893

(Figures 2, 3)

Callistochiton crassicosatus PILSBRY, 1893, 14: 264-265; pl. 58, figs. 1-6; 1898: 288 - BERRY, 1907: 52 - E. P. CHACE, 1917: 30 (Pleistocene) - E. P. & E. M. CHACE, 1919: 2 (Pleistocene) - DALL, 1921: 194 - BERRY, 1922: 409-410, 412, 414, 484-488; tbl. 1; text fig. 10; pl. 13, figs. 1-16 (Pleistocene) - OLDROYD, 1924: 194 - BERRY, 1926: 456 (Pleistocene) - JOHNSON & SNOOK, 1927: 565; fig. 665 - OLDROYD, 1927: 895 - STRONG, 1937: 194 - T. A. BURCH, 1942: 7 - A. G. SMITH, 1947: 18 - A. G. SMITH & GORDON, 1948: 208 - LA ROCQUE, 1953: 12 - LELOUP, 1953: 5-6; fig. 8 - LIGHT'S Manual, 2nd ed., 1954: 217-218 - G. & L. BURGHARDT, 1969: 11-12; pl. 1, fig. 5 - MCLEAN, 1969: 63; fig. 35.2 - ABBOTT, 1974: 399 - A. G. SMITH in Light's Manual, 3rd ed., 1974: 463-464

"*Callochiton fimbriatus* Cpr." COOPER, 1867: 23 [*nomen nudum*] [not *Chiton fimbriatus* Sowerby, 1840]

"*Chiton (Callochiton) fimbriatus* Cpr." ORCUTT, 1885: 544 [*nomen nudum*]; 1915: 23 [*nomen nudum*]

"*Callistochiton fimbriatus*' Carpenter, MS, *nomen nudum*" PALMER, 1958: 278

Description: Chiton with high arched, round back. Length up to 3 cm. Color creamy tan to gray or light green. Anterior valve with 7 strong, somewhat granose radial ribs, each often divided by 1-4 sulci which become more apparent towards the periphery. Posterior valve with 5 equally strong radial ribs, again often subdividing at the periphery; mucro well defined at the posterior edge of the valve with markedly sloped, almost vertical, and convex postmucro. Lateral areas of intermediate valves with a single, very strong radial rib, usually subdivided by 4-6 sulci; the radial ribs often show concentric annulations, about 12 per rib, which together with the radial sulci tend to divide the single rib into coarse granules. Central areas have longitudinal riblets, about 12 per side, which remain parallel to the jugum or may converge slightly anteriorly; the riblets are finely cross-ribbed. Girdle narrow, often banded and covered with close set, imbricating oval scales, about 100-120 μm in length, with some 6-8 deep striations (Figure 2). Articulamentum is white or bluish-white. Sutural laminae thin, semioval, separated by a relatively small, rounded sinus. Anterior valve with 8-9 very short teeth, thickened at the edges, festooned at the free edge; intermediate valves uni-slitted; posterior valve very thick and massive, with a series of 12-20 very short teeth, usually blunt and irregular in shape and size.

The radula of a specimen of *Callistochiton crassicosatus* 23.0 mm long (Monterey Bay, California, leg. A. J. Ferreira, September 1973, at 13 m, AJF 89) measures 8.0 mm in length, i. e., 35% of the specimen's length. It

has 48 rows of mature teeth, morphologically very similar to those of *Callistochiton palmulatus*. The median tooth is enlarged in front (where it bears a blade, 125 μm in width) and narrows posteriorly to about 50 μm ; in length it measures about 200 μm . The first laterals are subquadrate, with a knobby protuberance in the outer-anterior corner. The major (2nd) lateral has a bicuspid head, the inner cusp somewhat larger than the outer cusp (Figure 3); the head measures about 100 μm in width, and 100 μm in the length of the longest (inner) cusp. Outer marginal teeth are elongated, 140 μm long and 100 μm wide.

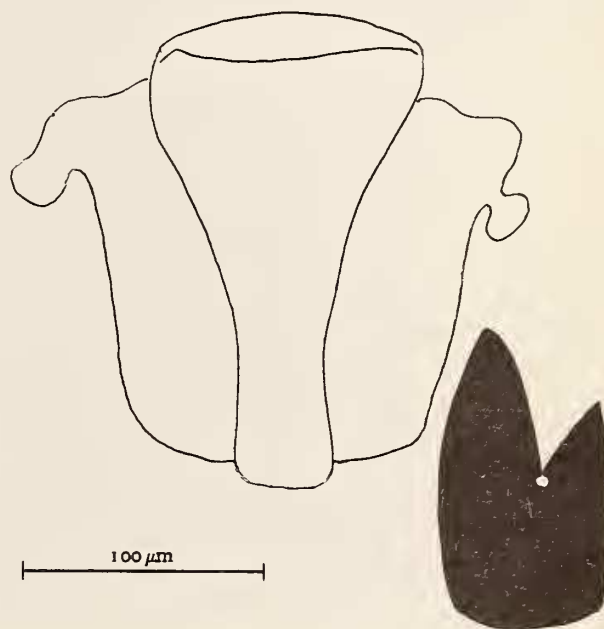


Figure 3

Callistochiton crassicosatus Pilsbry, 1893

Radula: Median tooth, first lateral teeth, and head of second lateral tooth. Specimen collected at Monterey Bay, California (AJF 89), original length 23.0 mm

Type Material: Syntype series (ANSP 118683), composed of 3 specimens, 1 wholly disarticulated but with girdle (Dr. Robert Robertson, *in litt.*, 24 August 1976). The disarticulated specimen, very likely the one illustrated by PILSBRY (1893, 14: pl. 58, figs. 4-6), is here designated as lectotype.

Type Locality: "Monterey [36°37'N, 121°55'W], California" as stated by PILSBRY (1893, 14: 265).

Distribution: Apparently continuous between parallels 36°N and 31°N. The northernmost record from the available collections is Trinidad [41°04'N, 124°10'W], Humboldt County, California (Glenn & Laura Burghardt Collection, *in litt.*, 9 August 1975); reported records from farther north, such as Puget Sound, Washington (OLDROYD, 1924: 194), and Forrester Island, Alaska (DALL, 1921: 194) have not been confirmed. *Callistochiton crassicosatus* is particularly abundant from Monterey Bay to San Diego, California. The verified southernmost record is Cedros Island [28°10'N, 115°15'W], Baja California, Mexico (SDNH 23474, *leg.* H. N. Lowe). On the offshore islands it has been collected at Santa Cruz (LACM-AHF 1660-48), San Miguel (CASG 13778), Catalina (LACM-AHF 1903-49), and Coronados (LA CM 63-41). Bathymetrically, it has been recorded from the intertidal zone to 27 - 31 m (LACM-AHF 1903-49). An unusual finding was the collection of a single specimen, estimated length 2.5 cm, at "400-350 fathoms [732 to 640 m] on mud, 11 miles [17.6 km] northeast of Avalon, Santa Catalina Island, Los Angeles County, California (33°27'24"N, 118°10'53"W), August 11, 1951," (LA CM-AHF 2049-51). It is also of interest to note that in the available collections I found no instance of the species having been collected between Punta Banda (31°43'N, 116°43'W), Baja California, Mexico (LACM 63-42), and the Cedros Island site, some 3° south, mentioned above.

Fossil Record: Pleistocene deposits in San Quintín, Lower California, Mexico (BERRY, 1926); Santa Monica Hills (CHACE, 1917), and San Pedro (CHACE & CHACE, 1919; BERRY, 1922) in southern California.

Remarks: The taxonomic position of "*Callistochiton fimbriatus*," a Carpenter manuscript name, has been sufficiently clarified in PILSBRY (1893, 14: 265 - 266) and PALMER (1958: 278 - 279) so as to require no further comment.

Callistochiton decoratus Pilsbry, 1893

"*Chiton* (*Callistochiton*) *decoratus* Cpr." ORCUTT, 1885: 544
[*nomen nudum*]

"*Callistochiton decoratus* Carpenter, n. sp." PILSBRY, 1893, 14: 269 - 270; pl. 58, figs. 17 - 20

Callistochiton decoratus. E. P. CHACE, 1917: 44 - E. P. & E. M. CHACE, 1919: 2 (Pleistocene) - DALL, 1921: 194 - OLDROYD, 1927: 896 - T. A. BURCH, 1942: 7 - PALMER, 1945: 101 - A. G. SMITH, 1947: 18 - LELOUP, 1953: 6 - 7; fig. 4 - PALMER, 1958: 278; pl. 33, figs. 15 - 21 - G. & L. BURGHARDT, 1969: 12; pl. 1, fig. 6 (with syn.: *C. chthonius* and *C. cyanosus*) - MCLEAN, 1969: 63; fig. 35.3 - ABBOTT, 1974: 39 (with syn. *C. punctocostatus*, *C. ferminicus*, *C. chthonius*, and *C. cyanosus*) - A. G. SMITH, 1977: 217, 240 (with syn. *C. cyanosus*, *C. decoratus punctocostatus*, and *C. chthonius*)

Callistochiton decoratus punctocostatus PILSBRY, 1896: 50 - DALL, 1921: 194 - BERRY, 1922: 409, 418, 481 - 483; tbl. 1; pl. 14, figs. 1 - 6 (Pleistocene) - OLDROYD, 1927: 897 - A. G. SMITH, 1947: 18 - A. G. SMITH & GORDON, 1948: 208 - G. & L. BURGHARDT, 1969: 12 - ABBOTT, 1974: 399 (syn. of *C. decoratus*) - A. G. SMITH, 1977: 217, 240 (syn. of *C. decoratus*)

Callistochiton decoratus ferminicus BERRY, 1922: 483; pl. 14, figs. 7 - 8 (Pleistocene) - ABBOTT, 1974: 399 (syn. of *C. decoratus*)

Callistochiton diegoensis THIELE, 1910: 86 - 87; pl. 9, figs. 4 - 10 - DALL, 1921: 194 - OLDROYD, 1927: 897 - A. G. SMITH, 1947: 18 - ABBOTT, 1974: 399

Callistochiton cyanosus DALL, 1919: 511; 1921: 194 - OLDROYD, 1927: 900 - A. G. SMITH, 1947: 18 - G. & L. BURGHARDT, 1969: 12 (syn. of *C. decoratus*) - ABBOTT, 1974: 399 (syn. of *C. decoratus*) - A. G. SMITH, 1977: 217, 240 (syn. of *C. decoratus*)

Callistochiton chthonius DALL, 1919: 511 - 512; 1921: 194 - OLDROYD, 1927: 900 - A. G. SMITH, 1947: 18 - G. & L. BURGHARDT, 1969: 12 (syn. of *C. decoratus*) - ABBOTT, 1974: 399 (syn. of *C. decoratus*) - A. G. SMITH, 1977: 217, 240 (syn. of *C. decoratus*)

Description: Chitons with relatively low-arched, round backs. Length up to 3 cm. Color usually uniform olive-green to tan, often with darker flecks. Anterior valve with 10 - 12 rounded radial ribs, of a relatively smooth surface except for some occasional growth rings; radial ribs separated by very well defined and pitted sulci. Posterior valve with 8 - 10 similar radial ribs; mucro well defined, slightly posterior. Lateral areas of intermediate valves bicostate, again with the 2 rounded ribs separated by a pitted sulcus. Central areas with 8 - 12 longitudinal rib-

Explanation of Figures 1, 2, 4, 5, 16, 17

Figure 1: *Callistochiton palmulatus* Dall, 1879. Girdle scales. SEM micrograph by Dennis Nichols and Myrl Stone × 700

Figure 2: *Callistochiton crassicosatus* Pilsbry, 1893. Girdle scales. SEM micrograph by Dennis Nichols and Myrl Stone × 300

Figure 4: *Callistochiton asthenes* (Berry, 1919). Girdle scales. SEM micrograph by Hans Bertsch × 300

Figure 5: *Callistochiton asthenes*. Girdle scales. SEM micrograph by Hans Bertsch × 1000

Figure 16: *Callistochiton colimensis* (A. G. Smith, 1961). Cuastocoma, Jalisco, Mexico (LACM 68-41). Length 17 mm

Figure 17: *Callistochiton colimensis*. Girdle scales. SEM micrograph by Hans Bertsch × 620



Figure 1

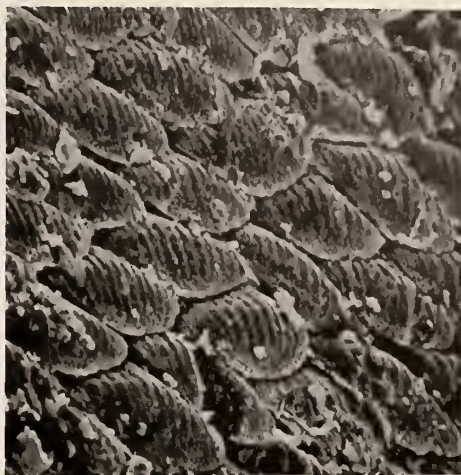


Figure 2



Figure 4



Figure 5



Figure 16



Figure 17



lets per side, parallel (or slightly divergent anteriorly), neatly cross-ribbed for a latticed effect. Jugum usually smooth (*i. e.*, not ribbed, the ribs having become obsolete), often lustrous and shiny, as if polished, a tegmental characteristic sometimes also noticed on the surface of the radial ribs of the end valves and lateral areas. Girdle, often banded, tan or dark green. Girdle scales strongly imbricated, oval, measuring about 160 - 200 μm in length, and showing 8 - 10 deep striations. Articulamentum white to bluish, often with a dark brown discoloration at the apex of the valve, particularly on valve viii. Sutural laminae relatively wide and semioval; sinus well defined, the sinusal lamina with a few irregular pectinations, usually separated by a small notch from the adjacent sutural laminae. Anterior valve with 9 - 11 teeth, thickened at the edges, festooned at the free edges; intermediate valves uni-slitted; posterior valve with 9 - 11 similar teeth. In some specimens the insertion plate of the posterior valve may be divided into very small teeth (over 25 in one small specimen examined), often short, irregular in shape and size, and not continued by a slit ray.

The radula is very similar to those of *Callistochiton palmulatus* and *C. crassicosatus*. A specimen 21 mm in length (San Clemente Island, California, *leg.* A. J. Ferreira, 26 October 1975, at 10m, AJF 252) has a radula measuring 6.7 mm in length, *i. e.*, 32% relative size, with 70 rows of mature teeth. Median tooth large in front (100 μm) where it has a small blade, tapers posteriorly; length of the tooth about 125 μm . First lateral teeth have a knobby protuberance in the outer-anterior corner. Second lateral has a bicuspid head about 50 μm in width; the inner cusp, the longest of the 2, is about 100 μm in length. The outer marginal teeth are elongated, measuring 100 μm in length, 80 μm in width.

Type Material: Holotype (ANSP 118687). "Although Pilsbry utilized Carpenter's manuscript name for this species, he did not use Carpenter's description or his type. Pilsbry's type was a specimen in the Academy of Natural History, Philadelphia." (PALMER, 1958: 278).

Callistochiton diegoensis Thiele, 1910: Holotype (Zoologisches Museum, Berlin). Color slides at CASIZ nos. 3339-3340

Callistochiton decoratus punctocostatus Pilsbry, 1896: Syntypes (ANSP 118689)

Callistochiton chthonius Dall, 1919: Holotype (USNM 109488)

Callistochiton cyanosus Dall, 1919: Holotype (USNM 109317)

Type Locality: "Todos Santos Bay and near San Tomas River [31°48'N, 116°42'W], Lower California" (PILSBRY, 1893, 14: 269).

Distribution: Continuous between parallels 34° N and 31°N. Northernmost record, Point Arguello [34°25'N, 120°39'W], Santa Barbara County, California (CASIZ 006298); southernmost record, Isla Cedros [28°10'N, 115°15'W], Baja California, Mexico (SDNH 23226). *Callistochiton decoratus* has also been collected at the offshore islands of Santa Cruz (AJF, December 1970), Santa Rosa (LACM 73-9), Anacapa (LACM M-41), Santa Barbara (LACM 72-97), Catalina (LACM-AHF 1652-48), San Clemente (LACM-AHF 1021-39), and Coronados (LACM A-5757). It is interesting to note that, just as with *C. crassicosatus*, there has been no recorded collection of *C. decoratus* between Punta China (31°33'N, 116°40'W), Baja California, Mexico (LACM-AHF 1596-47), and Cedros Island, some 3° south. The presence of *C. decoratus* in the Gulf of California, "... reported ... from La Paz by Carpenter (Pease coll.)" (PILSBRY, 1893, 14: 270), has never been confirmed. The known bathymetrical range of *C. decoratus* extends from the low intertidal zone to about 72 m (LACM-AHF 1191-40-D1, Santa Cruz Island).

Fossil Record: Pleistocene deposits in San Pedro, southern California (CHACE & CHACE, 1919; BERRY, 1922).

Remarks: The subspecies *Callistochiton decoratus punctocostatus* Pilsbry, 1896, is here placed in synonymy inasmuch as the alleged sculptural differences fall well within the range of intraspecific variation accorded to *C. decoratus*, as already noted by LELOUP (1953: 6 - 7), and A. G. SMITH (1977: 240). The synonymization of *C. cyanosus* Dall, 1919 and *C. chthonius* Dall, 1919, follows from Dall's original description, and the study of the holotypes, as reported by A. G. SMITH (*op. cit.*: 239 - 240).

The type material of *Callistochiton diegoensis* Thiele, 1910, consists of a single specimen preserved in alcohol in the repository of the Zoologisches Museum, Berlin, Deutsche Demokratische Republik. The specimen was made available for study through the generosity of Dr. R. Kiliass; it measures 17.0 mm in length and corresponds in every detail to the description and illustration provided by THIELE (1910); valves i, v, and viii, disarticulated and segregated in a vial, are those figured by THIELE (*op. cit.*, pl. 9, figs. 4 - 10). The specimen is unquestionably conspecific with *C. decoratus*; although the tegmental features are a bit sharper than usual, the deviation is well within the known intraspecific variation of the species.

Callistochiton decoratus ferminicus Berry, 1922, was placed in the synonymy of *C. decoratus* by LELOUP (1953); indeed, the stated distinctions would hardly justify a new name, particularly in view of the fact that, as Berry himself acknowledged, *C. decoratus* "is so extraordinarily variable a chiton" (BERRY, 1922: 483).

Callistochiton asthenes (Berry, 1919)

(Figures 4, 5, 6)

Ischnochiton (*Lepidozona*) *asthenes* BERRY, 1919a: 7; 1919b: 18-21; plt. 8, figs. 1-2*Ischnochiton asthenes*. DALL, 1921: 192 (in section *Lepidozona*)*Lepidozona asthenes*. A. G. SMITH, 1963: 148-149; 1966: 438-442 - G. & L. BURGHARDT, 1969: 20 - ABBOTT, 1974: 395*Callistochiton asthenes*. FERREIRA, 1978b: 39

Description: Chitons moderately elevated and slightly carinated. Length up to 1 cm. Tegmental surface microgranulose. Color cream to light brown. Anterior valve with 11-12 very low, broad, radial ribs, often very indistinct except at the periphery of the valve; in some specimens a radial series of 2-4 minute pustules (apparently easily abraded) may be observed cresting the radial ribs. Posterior valve with mucro anterior; post-mucro area with radial ribs similar to those in anterior valve, only usually much weaker and less distinct, obsolete in some specimens. Intermediate valves with lateral areas clearly raised in most specimens, bicostate, the ribs broad and flattened, bearing a series of 2-4 minute pustules. These pustules (or tubercles) are absent in most specimens examined, either because they are easily abraded (as BERRY, 1919, suggested), or perhaps because they had not (yet?) developed. Central areas with some 15 finely sculptured longitudinal riblets, subtly interlaticed; these riblets are not present in young specimens, and in older (larger) ones become obsolete towards the jugum which appears devoid of sculpturing except for the rather "scaly" microgranulose appearance of the tegmental surface. Articulation white. Sutural laminae thin and broadly arcuate; sinus small. Insertion teeth sharp, very slightly festooned and somewhat thicker at the edges. Slit formula of a specimen from the type locality: 9-1-9. Girdle covered with imbricated, oval, rather small scales (about 150 μ m in length), with about 10 ribs separated by neatly pitted striations (Figures 4, 5).

The radula is figured here for the first time (Figure 6). In a specimen 7.6 mm long (CASG 38607, White's Point, Los Angeles County, California, *leg.* W. J. Raymond, 1901), the radula measures 2.8 mm long (36%) and is composed of 36 rows of mature teeth. The median tooth is large in front (58 μ m in width) where it bears a thin blade, and tapers posteriorly; its length is about 70 μ m. First lateral teeth are rectangular with a knobby protuberance in the outer-anterior corner. Second (major) lateral has a bicuspid head which is about 45 μ m in width

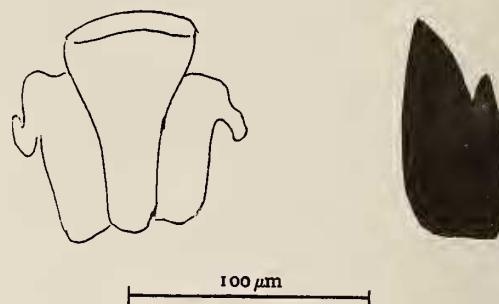


Figure 6

Callistochiton asthenes (Berry, 1919)

Radula: Median tooth, first lateral teeth, and head of second lateral tooth. Specimen collected at White's Point, California (CASG 38607), original length 7.6 mm

and 70 μ m in the length of the largest (inner) cusp. Outer marginal teeth are elongated, 75 μ m long, 45 μ m wide.

Type Material: Holotype, "preserved dry (S. S. B. 466), entered as Cat. No. 3913 in the author's [S. S. Berry] collection" (BERRY, 1919b: 20). Paratypes at USNM (332789), ANSP, CAS, and in A. G. Smith's private collection [now at CAS].

Type Locality: "Under stones at low tide, White's Point [33°42'N, 118°19'W], Los Angeles County, California" (BERRY, 1919b: 20).

Distribution: *Callistochiton asthenes* has been collected only in the general area of the type locality, Palos Verdes Peninsula, California, San Diego, California (SDNH 11637), and in the Coronados Islands, Guadalupe Island and Cedros Island, off the outer coast of Baja California, Mexico. From the type locality, the following lots were studied: 14 specimens, *leg.* W. J. Raymond 1901 (CASG 38607); "part of the type lot," *leg.* A. G. Smith 14-18 August 1916, 3 specimens (CASG 37998), and 11 specimens (CASG 43918); 10 specimens, July 1917 (SDNH 53830); 3 specimens, *leg.* E. P. Chace, 7 May 1950 (G. A. Hanselman Collection); 7 specimens *ex* George Willett Collection (UCLA 22402); 2 specimens, *leg.* S. Thorpe, July 1957 (LACM M-96). Recent attempts to collect the species at the type locality by myself (April 1974) and others (G. A. Hanselman, *in litt.*, 17 August 1974) have failed.

At Guadalupe Island (29°00'N, 118°16'W) *Callistochiton asthenes* was first collected by M. Woodbridge Williams, 7 December 1946, as a lot of 80+ specimens from a "tide pool at the south end" of the island (CASG 32746). On a recent expedition to Guadalupe Island, Dr. Welton L. Lee and I collected *C. asthenes* at 2 stations: 13 specimens at Northeastern Anchorage, 30 December 1974 (AJF 210), and 60 specimens at Sealers' Camp on the east side of the Island, 1 - 2 January 1975 (AJF 211).

From Coronado del Sur, Islas Los Coronados [32°25'N, 117°15'W] only one lot was found, composed of 2 specimens, 5 and 6 mm long, "ex Stephens Colln." (SDNH 53867).

From Cedros Island, Baja California, Mexico (28°10' N, 115°15'W), only 1 specimen was examined (SDNH 23625).

Callistochiton asthenes has only been collected in the intertidal zone, on the underside of rocks.

Remarks: *Callistochiton asthenes* joins the list of chitons that brood the young in the branchial groove (HYMAN, 1967: 114). Several of the specimens in the type lot (CASG 43918), and in the first lot collected at Guadalupe Island (CASG 32746) were observed to have several young specimens in the branchial groove.

One young in the branchial groove of *Callistochiton asthenes* 6.2 mm long was measured as 0.30 × 0.22 mm in size; it did not seem to have a (visible) girdle. Another of these young specimens had only 7 distinct valves. The significance of the brooding habit as exhibited by *C. asthenes* and many other species of chitons is not immediately apparent, although it has been regarded as "some stage in the development of viviparity" (DELL, 1965: 513) in chitons. It is a curious fact that none of the 73 specimens of *C. asthenes* collected at Guadalupe Island on 30 December 1974 to January 1975, at 2 different stations (AJF 210, 211) had young in the branchial grooves.

In length, *Callistochiton asthenes* does not usually attain 9 mm; the largest specimen examined measures 10.0 mm long (SDNH 23625).

Callistochiton leei Ferreira, spec. nov.

(Figures 7, 8, 9, 10, 11, 12)

Diagnosis: Very small (up to 8.5 mm long) chitons, mostly dark red maroon in color (Figure 7). End valves with about 12, lateral areas with 2 - 3 radial ribs which are well defined and granose. Central areas with 6 - 9 longitudinal riblets per side, with no latticing. Mucro anterior. Girdle often banded maroon and white. Girdle scales oval, smooth surfaced with no striations. Sutural

laminae sharp subquadrate. Slits corresponding to ribs; slit formula (holotype): 10 - 1 - 10.

Description: Holotype—When dried and fully extended, it measures, including girdle, 8.1 mm in length and 4.3 mm in width. Tegmentum uniformly dark "red wine" maroon. Anterior valve has 11 well defined radial ribs, strongly granose to the point of appearing tuberculated. These radial ribs are more like undulations of the tegmentum than "added on" ribs; they are seen to undulate the anterior margin of the valve. In the intermediate valves, the lateral areas show 2 similar radial ribs, well separated at the periphery. The central areas have some 8 well defined, slightly granose longitudinal riblets per side; there is no latticing, the space between the longitudinal riblets is wide, but featureless except for the microgranular surface that characterizes the whole tegmentum. The jugum is relatively smooth, *i. e.*, not ribbed. The posterior valve has an anterior mucro which, although well defined, is not too salient. The post-mucro area shows some 11 poorly marked, almost obsolete radial ribs. The articulamentum is white, somewhat translucent, the dark color of the tegmentum to shine through. The sutural laminae are moderately developed, sharp, thin, subquadrate. The sinus is relatively wide, and shows a minute sinusal lamina which, in some of the valves, displays a few discrete pectinations. The eaves are short and solid. The insertion plates are cut into teeth, with a slit formula 10 - 1 - 10. The teeth are slightly thickened at the edges, and very slightly festooned. The slits correspond in position to the radial ribs (undulations) of the tegmentum.

The girdle is faintly banded maroon and white. The girdle scales are oval, closely imbricated, about 150 μm in length; their outer surface is micropunctate with a sieve-like appearance, and no striations or other ornamentations (Figures 8, 9, 10). There is a marginal fringe of spicules about 50 - 60 μm long.

The gills extend the whole length of the foot.

The radula (Figure 11) measures 2.7 mm in length, *i. e.*, 34% of the specimen's length, and has 80 rows of mature teeth. The median tooth is quadrangular, measuring 37 μm in width by about 55 μm in length; it bears a relatively large blade on its anterior edge. The first lateral has a pointed prolongation on its outer-anterior corner; but its overall configuration is very difficult to determine with certainty in the preparation at hand. The second (major) lateral is tricuspid. The head is about 25 μm in width and 35 μm in the length of its middle (longest) cusp. The outer-marginal teeth are somewhat rounded, measuring 35 μm in length by 25 μm in width.

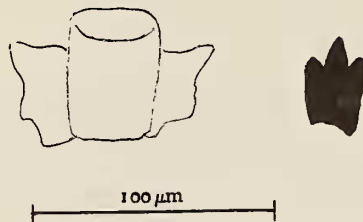


Figure 11

Callistochiton leei Ferreira, spec. nov.

Radula: Median tooth, first lateral teeth, and head of second lateral tooth. Holotype, Guadalupe Island, Baja California, Mexico (AJF 211), original length 8.1 mm

Type Material: Holotype (disarticulated valves, fragment of girdle, and mounted radula), is deposited at the California Academy of Sciences (CASIZ Type Series No. 705). Paratypes are deposited with the California Academy of Sciences (CASIZ Type Series No. 706); Natural History Museum of Los Angeles County (LACM 1905); National Museum of Natural History (USNM 749083); Academy of Natural Sciences of Philadelphia (ANSP 346418); American Museum of Natural History (AMNH 183817).

Color slides of paratypes are deposited at CASIZ, Color Slide Series.

Type Locality: Guadalupe Island, on the outer coast of Baja California, Mexico, at "Sealers' Camp," about the midpoint on the east side of the island (29°01'N, 118°13'W), where the holotype and 6 paratypes were collected at low tide in less than 1 m of water, by Welton L. Lee and Antonio J. Ferreira, 2 January 1975 (AJF 211).

Remarks: *Callistochiton leei* is known only from the type locality. The specimens collected were all about the same color, a dark maroon, with white along the jugum and central areas in some specimens; in size they varied between 8.5 and 4.8 mm in length, including girdle. With

C. asthenes, *C. leei* shares the habit of brooding the young. Four of the 7 specimens collected had minute juvenile chitons in the branchial grooves: one specimen had 2, one 3, one 8, and another 12 young. It is likely that there may have been more young chitons in the specimens collected, which may have fallen off during the collecting and preserving process that preceded examination. The young chitons measure about 500 μ m in length; all are white. They show all 8 valves distinctly, but seem to have no visible girdle (Figure 12). The finding that *C. leei* broods the young seems all the more remarkable when it is considered that these specimens share the habitat with *C. asthenes*, a species also known for brooding its young; yet, among the 60 specimens of *C. asthenes* collected at the same station (AJF 211), and 13 more collected at a nearby station (AJF 210), none was found to carry young in the branchial groove. This observation suggests that *C. leei* and *C. asthenes* have different breeding seasons.

Although *Callistochiton leei* seems to be closely related to *C. asthenes*, they are absolutely distinct in color, sculpture of tegmentum, and girdle scales.

Callistochiton leei is endemic to Guadalupe Island, as is *Lepidozona guadalupensis* Ferreira, 1978. Based on a list of the chiton species previously known on the island (A. G. SMITH, 1963), the finding of *C. leei* raises the percentage of chiton endemism at Guadalupe Island to 20%.

The species is called *leei* after Dr. Welton L. Lee, Chairman, Department of Invertebrate Zoology, California Academy of Sciences, who shared in the collecting of the species at Guadalupe, and who has helped me generously and enthusiastically in every phase of this and other works.

Callistochiton gabbi Pilsbry, 1893

(Figures 13, 14, 15)

Callistochiton gabbi PILSBRY, 1893, 14: 270-271; pl. 60, figs. 7-10 - PILSBRY & LOWE, 1932: 129 - [?] BERGENHAYN, 1936: 282-284; text figs. 3a-3e [? misidentified] - KEEN,

Explanation of Figures 7 to 10 and 12

Figure 7: *Callistochiton leei* Ferreira, spec. nov. Paratype. 8.5 mm long

Figures 8, 9, and 10: *Callistochiton leei* Ferreira, spec. nov. Holotype. Girdle scales. SEM micrographs by Hans Bertsch, $\times 100$, $\times 300$ and $\times 600$, respectively

Figure 12: *Callistochiton leei* Ferreira spec. nov. Young specimen, about 500 μ m in length. SEM micrograph by Hans Bertsch $\times 160$

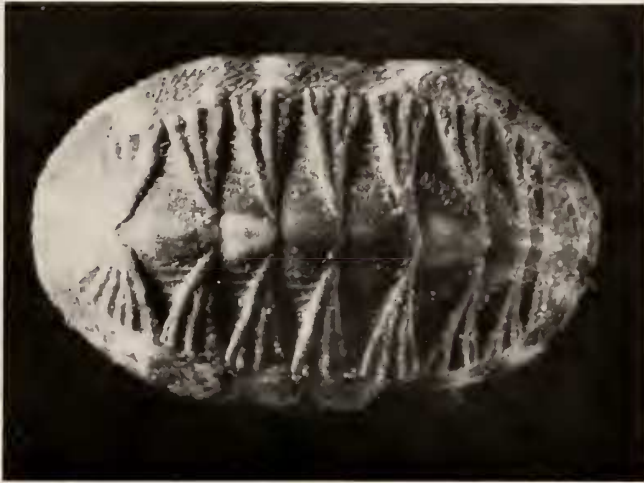


Figure 7

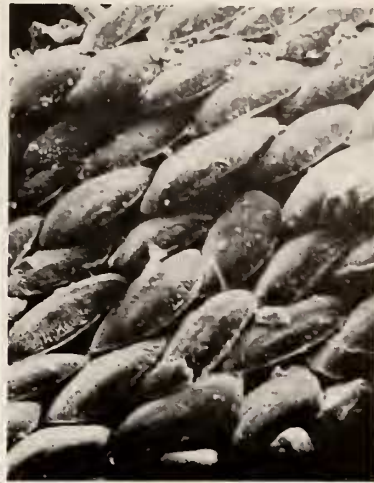


Figure 8



Figure 9



Figure 10

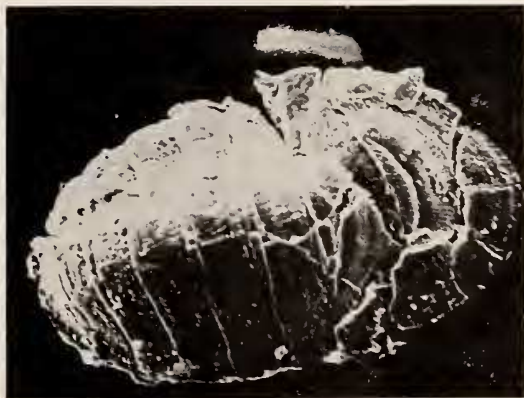


Figure 12



- 1958: 522; Amphineura fig. 27 - LINDSAY, 1966: 347 - THORPE in Keen, 1971: 873; Polyplacophora, fig. 28 - ABBOTT, 1974: 399 - A. G. SMITH & FERREIRA, 1977: 88
Callistochiton infortunatus PILSBRY, 1893, 14: 266; plt. 59, figs. 37-42 - DALL, 1909: 246 - PILSBRY & LOWE, 1932: 129 - STRONG, 1937: 194 - STEINBECK & RICKETTS, 1941: 552; plt. 27, fig. 2 - A. G. SMITH & GORDON, 1948: 208 - KEEN, 1958: 522; Amphineura, fig. 28 - LINDSAY, 1966: 347 - THORPE in Keen, 1971: 873; Polyplacophora, fig. 29 - ABBOTT, 1974: 399
Callistochiton decoratus infortunatus. DALL, 1921: 194 - OLDROYD, 1927: 896-897 - A. G. SMITH, 1947: 18
Callistochiton leidensis NIERSTRASZ, 1905: 143-145; plt. 9, figs. 2-10

Description: Roundly arched to subcarinated chitons. Length up to 2 cm. Color tan to rusty brown or dark green. Anterior valves with 8-10 well defined radial ribs separated by pitted spaces about as wide as the ribs; the radial ribs are somewhat triangular in cross-section, and often crowned by a series of 6-10 small knobs. Posterior valve rather variable in shape, from elevated and strongly convex to low and flat; mucro central; 7-10 radial ribs in the post-mucro area, usually not quite as well defined as those in the anterior valve. In the intermediate valves, the lateral areas are bicostate, the radial ribs with the same characteristics as in the anterior valve. Central area shows longitudinal riblets, 10-15 per side, finely latticed and with a tendency to diverge forward. The articulamentum is whitish to olivaceous, often with a dark brown discoloration at the apex of the end valves. Sutural plates subquadrate; sinus relatively narrow. Insertion teeth short and with festooned free edges. Slit formula 9-1-8. Eaves solid and narrow. Girdle often

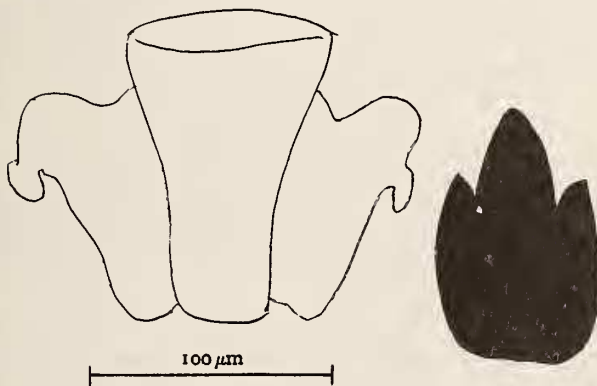


Figure 14

Callistochiton gabbi Pilsbry, 1893

Radula: Median tooth, first lateral teeth, and head of second lateral tooth. Specimen collected at Guaymas, Sonora, Mexico (LACM 64-4), original length 16.0 mm

banded, covered with oval imbricating scales, about 150 μm in length, and with 12-15 fine striations (Figure 13).

The radula is figured here for the first time (Figure 14). The specimen (LACM 64-4, Guaymas, Sonora, Mexico, leg. J. H. McLean, 30 January to 2 February 1964, at 5-13 m), from a lot of 18 specimens, measures 16.0 mm in length. The radula is 5.2 mm long, that is 32% of the body length, and has 55 rows of mature teeth. The median tooth is larger in front where it measures 88 μm in width, and has a small blade; the tooth narrows posteriorly to about 43 μm . It is about 120 μm long. The first lateral teeth are somewhat quadrangular, often showing a small knob at the outer-anterior corner. The second (major) lateral teeth have a tricuspid head which measures about 60 μm in width, and 75 μm in the length of its middle (longest) cusp. Outer marginal teeth are elongated, about 75 μm long and 60 μm wide.

Type Material: Holotype (ANSP 118691) (Figure 15).

Type Locality: "Gulf of California" (PILSBRY, 1893, 14: 270), here restricted to Puertecitos (30°20'N, 114°39'W), Baja California, Mexico.

Distribution: Throughout the Gulf of California, Mexico, to Ecuador. *Callistochiton gabbi* has been collected practically everywhere in the Gulf of California from San Felipe to Cabo de San Lucas, from Puerto Peñasco, Sonora to Mazatlan, Sinaloa, including Bahía de Concepcion, and islands of Tiburon, Angel de la Guarda, Carmen, Danzante, San José, Espíritu Santo, Cerralvo, and others. Although with less abundance, *C. gabbi* has also been found in southern Mexico, at Isla Isabella, Nayarit (LACM-AHF 19; LACM-AHF 124-33), Banderas Bay (LACM 71-83), Bahía Cuastocomate, Jalisco (LACM 68-41), Santiago Peninsula, Colimas (LACM 63-10), Zihuatanejo (AJF 305) and Acapulco, Guerrero (AJF 307); Puerto Escondido (AJF 300) and Puerto Angel, Oaxaca (AJF 302); and farther south, Bahía Herradura, Costa Rica (LACM 75-52), Taboga Island, Panama (LACM 65-25), and Punta Ancón, Santa Elena Peninsula [2°20'N, 80°53'W], Ecuador, its southernmost record (LACM 70-11 & 70-12, leg. J. H. McLean, 6-7 March 1970). Bathymetrically, *C. gabbi* has been found from low intertidal to "20-40 fathoms" [37-73 m] (LACM 38-5).

Remarks: PILSBRY (1893) described *Callistochiton gabbi* 4 pages after describing *C. infortunatus* "from Carpenter MSS and unpublished drawings of his types" in the Manual of Conchology.

While he attempted to distinguish *Callistochiton gabbi* from other similar species such as *C. decoratus*, *C. elenensis*, and even "Carpenter's unfigured *Ischnochiton ex-*

pressus," he failed to mention the extraordinary similarities between *C. gabbi* and *C. infortunatus*. Despite the awareness that both nominal species came from the same general locality, the Gulf of California and the Panamic province, Pilsbry's differential diagnosis was limited to the profile of the tail valve which he described as "convex, mucro obtuse" in *C. infortunatus*, and "rapidly sloping backward from the front margin, mucro flat" in *C. gabbi* (PILSBRY, 1893: 262; "Key to species of *Callistochiton*").

The examination of many lots of *Callistochiton* from the Gulf of California down to Central and South America has convinced me that Pilsbry's species-group names, *C. gabbi* and *C. infortunatus*, refer to the same zoological species. The alleged differences in tail-valve profile and mucro appeared highly unreliable for distinguishing the 2 forms inasmuch as there are many specimens showing intergradation, often collected side by side at the same station; and no other characters, such as color, tegmental sculpture, articulamentum, girdle scales, or radula correlated in any significant manner with either morph.

However, it is not without some justification that authors have adhered to, or at least left unquestioned Pilsbry's notion of 2 species. *Callistochiton gabbi* is given to considerable intraspecific variation in color, sharpness of sculptural features, number of radial ribs in the end-valves, and profile and mucro of the tail valve. In color, specimens from the Gulf of California tend to be drabby looking, tan to olive, whereas specimens from the southern part of the range tend to be much more colorful, sometimes in bright creamy browns, with reddish hues, even suffusions of cobalt-blue as was seen in a specimen from Taboga Island, Panama. In the number of ribs in the anterior valve, specimens from the Gulf of California tend to have 9 radial ribs (in a sample of 75 randomly selected specimens from the Gulf of California, 96% had 9 ribs in the anterior valve, 4% had 8), while specimens from southern locations tend to have 8 (in a sample of 16 specimens, 94% had 8, 6% had 9 ribs in the anterior valve). In both geographic populations the number of ribs in the posterior valve shows greater fluctuation. Of the samples mentioned, in the Gulf of California 10% of the specimens had 6 radial ribs, 30% had 7, 30% had 8, 25% had 9, and 6% had 10; while in the southern range 6% had 6, 62% had 7, 19% had 8, and 12% had 9 radial ribs. In the case of the profile and mucro of the tail valve a definition of the morphs "*infortunatus*" (elevated mucro, convex post-mucro) and "*gabbi*" (low mucro, flat post-mucro) was made difficult as there were many intergradations. Considering only the extreme cases, *i. e.*, those specimens that clearly fit the definition "*gabbi*" or "*infortunatus*," it was a simple matter to

conclude that the morph "*gabbi*" was virtually confined to the Gulf of California, whereas the morph "*infortunatus*" was to be found throughout the range from the upper Gulf of California to Ecuador. In considering all the specimens available to me, there are many instances when the tail valve could not be so easily classified one way or the other, and all manners of intergradation of the mucro and the posterior valve's profile could be seen between the two extremes, "*infortunatus*" and "*gabbi*." Often, these extremes and intergradations were found in specimens from the same lot; for instance, a lot of 31 specimens from Saladita Cove, Guaymas, Sonora (LACM 68-27) contained 18 specimens that would be classified as "*gabbi*," 7 as "*infortunatus*," and 6 as "in between." In a lot of 16 from Puertecitos, Baja California (LACM 62-19) only about 2 or 3 specimens would fit a rigorous definition of "*gabbi*," 1 or 2 that of "*infortunatus*"; whereas the bulk of the lot, some 12 specimens, would have to be regarded as intermediates.

As first reviser, I have selected the name *Callistochiton gabbi* for the species. Despite the fact that *C. infortunatus* has page priority, the name *C. gabbi* has the advantage of an already assigned type specimen (there is none for *C. infortunatus*), and a less ambiguous type locality and description. The examination of the holotype of *C. gabbi* was made possible through the kindness of Dr. Robert Robertson, Curator, Academy of Natural Sciences, Philadelphia.

Callistochiton leidensis Nierstraß, 1905, described from a single specimen, 8mm long, collected at "Porta Santae Elenae" [? Ecuador] appears to be, from the description and figures, a synonym of *C. gabbi* as here defined.

Callistochiton colimensis (A. G. Smith, 1961)

(Figures 16, 17, 18)

Ischnochiton colimensis A. G. SMITH, 1961: 86-87; pl. 9, fig. 2

Callistochiton colimensis THORPE in KEEN, 1971: 873; fig. 26
Ischnochiton lowei PILSBRY in Pilsbry & Lowe, 1932: 129 [*nomen nudum*]

Description: Oval, relatively high arched, somewhat carinated chitons (Figure 16). Length up to 2.5 cm. Color predominantly golden brown to cinnamon. Tegmental surface microgranular. Anterior valve with 11 - 13 strongly defined radial ribs, with a tendency to twin towards the periphery, crowned by minute, 100 µm in diameter, round tubercles. Lateral areas of intermediate valves usually bicostate; however, in large specimens a sulcus

often appears in the rib dividing it radially. Radial ribs similar to those in anterior valve, crowned by minute tubercles, about 6 - 8 per rib. Central area has longitudinal riblets, about 10 per side, which remain parallel to the jugum or, as is more commonly the case, tend to converge somewhat forward. Riblets, separated by cross-ribbed spaces, become crowded towards the jugum. Jugal area longitudinally ribbed; there is no wedge-like figure on valve ii (such as seen in many species of *Lepidozona*). Mucro of posterior valve slightly but definitely anterior; post-mucro with 10 - 11 radial ribs similar to those in anterior valve. Girdle, sometimes faintly banded, is covered with closely imbricated oval scales, up to 240 μm in length, displaying 10 - 16 fine striations (Figure 17).

Articulamentum white. Sutural laminae semioval and sharp; sinus shallow. Insertion plates with relatively sharp teeth, vaguely thicker at the edges, but showing no festooning. Slit formula of paratype, 10 - 1 - 10; of another specimen examined, 9 - 1 - 9. Slits correspond in number and position to the tegmental ribs.

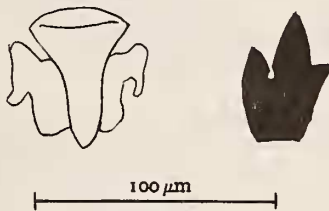


Figure 18

Callistochiton colimensis (A. G. Smith, 1961)

Radula: Median tooth, first lateral teeth, and head of second lateral tooth. Specimen collected in Gulf of Tehuantepec, Mexico (Don Shasky collection), original length 7.5 mm

The radula is figured here for the first time (Figure 18). In a specimen 7.5 mm long (Don Shasky Collection: "45 fathoms [82 m], rocky bottom, San Juan Exped., Gulf of Tehuantepec [Mexico], July 10, 1963, leg. Don Shasky"). the radula measures 2.75 mm in length, and has 46 rows of mature teeth. Relative length, 37%. Median tooth wider in front, where it measures about 50 μm in width, and bears a thin blade; posteriorly, it narrows rapidly to 25 μm , tapering to a point. In length it measures about 60 μm . The first lateral teeth are not easily visualized in this particular preparation; they are somewhat quadrangular, and slightly angulated at the outer-anterior corner. The second (major) lateral teeth have a tricuspid head, about 38 μm wide; the middle cusp, the longest, is about 50 μm

long. Of the other 2 cusps, the outer cusp is the larger; the inner cusp is small, hardly noticeable. Outer marginal teeth are somewhat elongated, about 53 μm long and 38 μm wide.

Type Material: Holotype (ANSP 152139); one paratype (CASG 12342).

Type Locality: "Manzanillo [19°03'N, 104°20'W], Colima, Mexico," collected by H. N. Lowe, 1930.

Distribution: *Callistochiton colimensis* is quite rare, although its geographic range known at present extends from 23°N to 8°N. Specimens from the following stations were examined: "Pinnacle north of Pescadero Canyon [23°00', 109°35.7'W, its northernmost record], off San José del Cabo, inside Inner Gorda Bank," Gulf of California, Mexico, at 330 - 340 m (CASIZ, leg. R. H. Parker, R/V *Spencer F. Baird*, Vermillion Sea Expedition, 28 March 1959, 2 specimens); Los Arcos [20°40'N, 105°20'W], Banderas Bay, Jalisco, Mexico, at 5 - 24 m (LACM 65-15, leg. J. H. McLean & C. Miller, 22-24 March 1965, 1 specimen); Bahía Cuastocomate [19°14'N, 104°45'W], Jalisco, Mexico, 5 - 22 m (LACM 68-41, leg. H. J. McLean & Oringer, 13 - 21 October 1968, 5 specimens); Manzanillo [19°03'N, 104°20'W], Colima, Mexico, intertidal (CASG 12342, leg. H. N. Lowe, 1930, 2 specimens, type lot, only paratype examined); Gulf of Tehuantepec [15°08'N, 93°23'W], Mexico, 82 m (Don Shasky Collection, leg. D. Shasky, San Juan Expedition, Sta. N-13, 10 July 1963, 6 specimens); Port Parker [10°58'N, 85°49'W], Costa Rica, 9 m (LACM-AHF 468-35, 9 February 1965, 2 specimens); Bahía Elena [10°57'N, 85°46'W], Costa Rica, 26 - 53 m (LACM 72-12, leg. P. LaFollette & D. Cadien, R/V *Searcher*, Sta. 392, 14 February 1972, 2 specimens); Isla Contadora [8°38'N, 79°02'W], Archipiélago de las Perlas, Gulf of Panama, Panama, 2 - 6 m, (AJF 224, leg. A. J. & N. J. Ferreira, 17 - 19 February 1975, 1 specimen).

The bathymetric range of *Callistochiton colimensis* established by these collections extends from the intertidal zone to 330 - 340 m.

Remarks: The similarities between *Callistochiton colimensis* and *C. asthenes* are noteworthy: (1) the tegmentum has similar texture; (2) the end-valves and the lateral areas of the intermediate valves have about the same number of radial ribs; (3) the radial ribs are crowned by a series of minute tubercles; (4) the mucro is anterior; (5) the central areas have about the same number of latticed longitudinal riblets; (6) the girdle scales are about the same size and striated. Yet the 2 species are quite distinct: (1) in size, *C. colimensis* reaches

lengths 3 times that of *C. asthenes*; (2) much warmer and brighter color can be seen in *C. colimensis*; (3) the radial ribs are much better defined, more rounded, and stronger, with a tendency to twin in *C. colimensis*; (4) the longitudinal ribs and latticing of the central areas are boldly sculptured in *C. colimensis*, only faintly visible in *C. asthenes*; (5) at the jugum, the longitudinal riblets are crowded but clearly present in *C. colimensis*, while invariably absent in *C. asthenes*; and (6) the girdle scales have more and finer striations in *C. colimensis* than in *C. asthenes*, and the pitted appearance of the striae, characteristic of the latter, is not present in the former. Still, young specimens of *C. colimensis* look remarkably similar to *C. asthenes*, and the differential diagnosis based on a single such specimen may prove rather difficult. In view of these similarities, it seems probable that the 2 species, *C. colimensis* and *C. asthenes* are closely related and share a common ancestral line.

Callistochiton elenensis (Sowerby, 1832)

(Figures 19, 20, 21)

- Chiton elenensis* SOWERBY in Broderip & Sowerby, 1832: 27 - MÜLLER, 1836: 164 - SOWERBY, 1840: 6, sp. no. 79 [spelled "ellinensis"]; p. 10, fig. 69 - [?] REEVE, 1847: sp. no. 116; pl. 19, fig. 116 (syn. of *Chiton janeirensis* Gray, 1828) - CARPENTER, 1857: 180, 318
- Ischnochiton elenensis*. CARPENTER, 1864: 552 - 553 [reprinted, 1872: 38, 39]; 1865: 275 [reprinted, 1872: 266]
- Callistochiton elenensis*. HADDON, 1886: 20 - PILSBRY, 1893, 14: 267 - 268 - DALL, 1909: 246 - KEEN, 1958: 522 - FERREIRA, 1974: 175; 1976: 49
- Lepidozona elenensis*. THORPE in Keen, 1971: 871, Polyplacophora, fig. 33 (with syn. *Lepidopleurus clathratus* Carpenter, 1857, *Ischnochiton expressus* Carpenter 1865, and *I. subclathratus* Pilsbry, 1892)
- Callistochiton flavidus* THIELE, 1910: 87 - 88; pl. 9, figs. 14 to 17 - KEEN, 1958: 522; Amphineura fig. 26 - [?] RICHIE, 1971: 133, 141 - FERREIRA, 1974: 173
- Lepidozona flavida*. THORPE in Keen, 1971: 875; Polyplacophora, fig. 34

- Ischnochiton expressus* CARPENTER, 1864: 552 [reprinted, 1872: 38] (*nomen nudum*); 1865: 275 - 276 [reprinted, 1872: 266 - 267] - THORPE in Keen, 1971: 871 (syn. of *Lepidozona elenensis*)
- Callistochiton expressus* PILSBRY, 1893, 14: 268 - 269 - KEEN, 1958: 522

Description: Relatively high arched, and carinated chitons. Length up to 11 mm. Color tan to creamy brown, sometimes reddish or greenish. Anterior valve with 11 - 12 rounded to flattish ribs, in some specimens slightly granose; the ribs are more like undulations of the tegmentum than "added on" features, the space between the "ribs" being as wide as the ribs themselves. The lateral areas of the intermediate valves are well marked by the presence of 2 radial ribs, similar to those found in the anterior valve; the anterior rib of the lateral areas is usually quite smooth in appearance while the posterior rib is often granose conferring a serrated appearance to the sutural space. The central areas have about 10 longitudinal riblets per side, which tend to diverge forwardly and are cross-ribbed very weakly in most specimens. The jugal area is usually ribbed, too. The posterior part of the valves iv to vii, particularly the latter, have an upswept appearance which gives the specimen a peaked profile. The posterior valve has a central, rather flat mucro; post-mucro area is depressed, with 8 - 11 radial ribs very poorly defined. The girdle is covered by oval, imbricating scales, about 100 μ m in length, with some 20 ribs separated by deep striations (Figures 19, 20).

The articulamentum is whitish; often a brown discoloration may be seen at apex of valve viii. Sutural laminae are semioval and sharp; sinus quadrate. Insertion plates are cut into relatively sharp teeth; festooning is not obvious, but there seems to be some thickening of the edges of the teeth. Slit formula of a specimen 8.5 mm long (AJF 134, Masachapa, Nicaragua, leg. A. J. Ferreira, 23 January 1974) is 9 - 1 - 9.

Radula of the same specimen (Figure 21) measures 2.7 mm in length (relative length, 32%) and has some 30

Explanation of Figures 13, 15, 19, 20, 22, 23, 25

Figure 13: *Callistochiton gabbi* Pilsbry, 1893. Girdle scales. SEM micrograph by Dennis Nichols and Myrl Stone $\times 100$

Figure 15: *Callistochiton gabbi*. Holotype (ANSP 118691)

Figures 19 and 20: *Callistochiton elenensis* (Sowerby, 1832). Girdle scales. SEM micrographs by Hans Bertsch $\times 300$ and $\times 1000$, respectively

Figures 22 and 23: *Callistochiton periconis* Dall, 1908. Girdle scales. SEM micrographs by Hans Bertsch $\times 650$

Figure 25: *Callistochiton pulchellus* (Gray, 1828). Lectotype (BM(NH)197739)



Figure 19



Figure 20



Figure 22



Figure 23



Figure 15

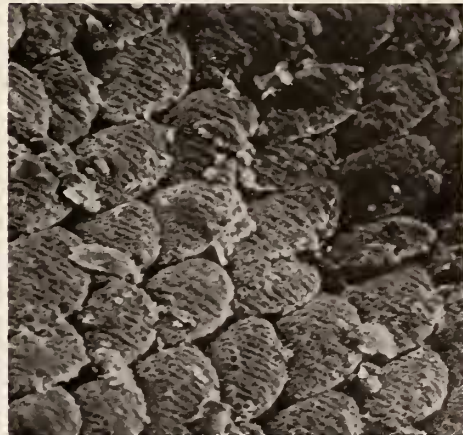


Figure 13



Figure 25



rows of mature teeth. The median tooth is wider anteriorly where it bears a thin blade, and measures $65\ \mu\text{m}$ in width; posteriorly, it narrows to $25\ \mu\text{m}$ and then enlarges into a bulb $35\ \mu\text{m}$ in diameter. In length it measures about $90\ \mu\text{m}$. The first lateral teeth are quadrangular with a knobby protuberance at the outer-anterior corner. The second (major) lateral teeth have a unicuspid head, measuring about $50\ \mu\text{m}$ in width, and $85\ \mu\text{m}$ in length. The outer marginal teeth are quite elongated, $75\ \mu\text{m}$ long and $38\ \mu\text{m}$ wide.

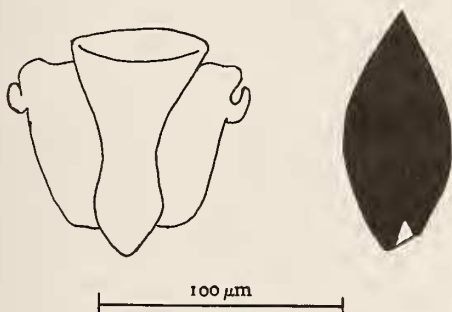


Figure 21

Callistochiton elenensis (Sowerby, 1832)

Radula: Median tooth, first lateral teeth, and head of second lateral tooth. Specimen collected at Massachapa, Nicaragua (AJF 134), original length 8.5 mm

Type Material: Sowerby's type material of *Chiton elenensis* is presumed lost or never designated. However, the species was illustrated, though poorly, by Sowerby in the Conchological Illustrations (fig. 69) [reprinted in PILSBRY, 1893, 14: pl. 59, figs. 27-28] and there seems to be no confusion in the current literature as to the zoological species involved. The "exceptional circumstances" for the naming of a neotype (ICZN, Article 75) do not seem to be present, and none is designated herein.

The whereabouts of Thiele's type material of *Callistochiton flavidus* is unknown; it was not found at the Museum of the Humboldt-Universität, Berlin (Dr. Rudolf Kiliass, *in litt.*, 31 January 1977).

The type material of Carpenter's *Ischnochiton expressus*, if ever designated, could not be located at the U. S. National Museum of Natural History (Dr. J. Rosewater, *in litt.*, 24 March 1977) or at the Academy of Natural Sciences of Philadelphia (M. Miller, *in litt.*, 27 March 1978).

Type Locality: "St. Elena [?Ecuador] and Panama" (SOWERBY, 1832: 27).

Distribution: *Callistochiton elenensis* seems to have a continuous distribution between the parallels 23°N and 2°S . The northernmost record is Playa Cerrito [$23^{\circ}20'\text{N}$, $106^{\circ}30'\text{W}$], some 15 km N of Mazatlan, Sinaloa, Mexico (AJF 427, *leg.* A. J. & N. J. Ferreira, 7 July 1978, 6 specimens at 1-3 m). The southernmost record is Punta Ancón ($2^{\circ}20'\text{S}$, $80^{\circ}53.5'\text{W}$), Santa Elena Peninsula, Ecuador (LACM 70-12, *leg.* J. H. McLean, 7 March 1970, intertidally). Bathymetrically, the species ranges from the low intertidal zone to 18-90 m (CASG 23779).

Remarks: *Callistochiton elenensis* has a sibling species in the Caribbean, *C. portobelensis* Ferreira, 1974, from which it differs by its (1) somewhat sharper tegmental features, (2) more angular and carinated appearance, (3) frequent presence of longitudinal riblets at the jugum, (4) "upswept" appearance of valves vi and vii, (5) thinner and more widely separated longitudinal riblets, and (6) ornamentation of the girdle scales [only evident in SEM micrographs, cf. Figures 19, 20 with FERREIRA 1974: figs. 3-5].

The synonymization of *Callistochiton flavidus* Thiele, 1910, is based upon the description and illustration of the species by Thiele. Although I have not been able to examine Thiele's type, it is quite clear that the specimen before him, a single specimen 6 mm long from Champerico [$14^{\circ}18'\text{N}$, $91^{\circ}55'\text{W}$], Guatemala, was a juvenile of *C. elenensis*.

The report of *Callistochiton flavidus* in Brazil (RICH, 1971) could not be verified; I consider it extremely doubtful, and most likely a misidentification.

The placing of *Callistochiton expressus* (Carpenter, 1865) in the synonymy of *C. elenensis* was already suggested by Carpenter himself when describing *Ischnochiton* (?var.) *expressus*, upon the examination of only 2 specimens, with the statement that they had "a strong general resemblance to *I. elenensis*" (CARPENTER, 1865: 276). Now, with more material available, and a fuller appreciation of the extent of intraspecific variation in *C. elenensis*, the conclusion of conspecificity becomes obvious.

On describing *Chiton elenensis*, SOWERBY (1832: 27) remarked: "This is the *Chiton Janeirensis*, var.?, Gray. It is unquestionably a distinct species, as Mr. Gray hints it may be, from his *Chit. Janeirensis*." Of course, Sowerby was correct in judging his *Chiton elenensis* to be distinct from *Chiton janeirensis* Gray, 1828 [type locality: Rio de Janeiro, Brazil]; but he was incorrect in considering *C. elenensis* conspecific with "*Chiton janeirensis* (var.?)

Gray, 1828" [type locality: Valparaiso, Chile]. Thanks to the generosity of Aileen Blake, Mollusca Section, Department of Zoology, British Museum (Natural History), I had the opportunity of examining the type material of the species in question. As reported elsewhere (FERREIRA, 1978b), the examination of the type specimens revealed that *Chiton janeirensis* Gray, 1828, from Rio de Janeiro is indeed distinct from "*Chiton janeirensis* (var.?)" Gray, 1828, from Valparaiso; while the former species retains its name as type species of the genus *Calloplax* Thiele, 1909, the latter, also a *Calloplax*, appeared to be conspecific with the later-named *Callistochiton viviparus* Plate, 1899.

Likely, on the strength of SOWERBY'S (1832) own statement that *Chiton elenensis* "is the *Chiton Janeirensis*, var.?, Gray", REEVE (1847) was also led into confusion and error. In the Monograph, having already described *Chiton janeirensis* Gray, "*Hab. Rio Janeiro*" (plt. 15, sp. 80), Reeve "discovered" and, as such, described what he believed to be the authentic *C. janeirensis*, "*Hab. Rio Janeiro. St. Elena, West Columbia [sic]; Cuming*," (*op. cit.*: plt. 19, sp. 116). Thus, he proposed the name *C. sowerbianus* [listed as species "80. *Sowerbyi* Reeve" in the "Detail of Sculpture" part of the Monograph] for the species first described (sp. 80), and relegated *Chiton elenensis* Sowerby to the synonymy of the *C. janeirensis* Gray (sp. 116) as later described.

The examination of the chiton specimens from the Cuming Collection that apparently caused Reeve to re-describe *Chiton janeirensis* proved to be of more than historical interest. Loaned for study through the generosity of Aileen Blake (BMNH), the lot consists of 5 specimens preserved dry and in good condition. The specimens, varying in length from 9.2 to 15.0 mm, are accompanied by a Museum label which reads: "B. M. (N. H.) reg. no.: / *Chiton janeirensis* Gray / FIGURED SPECIMEN / Rio Janeiro / H. CUMING colln. / 5 specs. Acc. no: 1829 / *Conc. Icon. 4 Chiton / pl. XIX sp. 116 fig. 116, / (fig. = largest spec.), / Reeve.*" On the face of the wooden tablet underneath the glued specimens, is handwritten in ink: "*Leptochiton Janeirensis* Gray / Rio Janeiro: St. Elena." Examination of the specimens on the tablet reveals that 4 of them, including the figured one, conform in all respects to the present concept of *Calloplax janeirensis* (Gray, 1828); however, the remaining specimen, the smallest of the lot (9.2 mm in length) is not *C. janeirensis* but *Calloplax vivipara* (Plate, 1902) [type locality, Urica, Chile; see FERREIRA, 1978], a species which, if girdle characteristics are disregarded, does resemble *Chiton elenensis* Sowerby.

Callistochiton periconis Dall, 1908

(Figures 22, 23, 24)

- Callistochiton periconis* DALL, 1908: 355-356 - KEEN, 1958: 522 - THORPE in Keen, 1971: 873 (syn. of *C. pulchellus* (Gray, 1828)) - A. G. SMITH, 1977: 217, 242-243 (syn. of *C. pulchellus* (Gray, 1828))
- "*Chiton pulchellus* Gray" - C. B. ADAMS, 1852: 243 - CARPENTER, 1857: 277; 1864a: 362 [reprinted, 1872: 198]; 1864b: 552 [reprinted, 1872: 38] [not *Chiton pulchellus* Gray, 1828]
- "*Chiton (Callochiton) pulchellus* Gray." MÖRCH, 1861: 176 [not *Chiton pulchellus* Gray, 1828]
- "*Callochiton pulchellus*: diagn. auct." CARPENTER, 1857: 317; 1865: 276 [reprinted, 1872: 267] [not *Chiton pulchellus* Gray, 1828]
- "*Callistochiton pulchellus* (Gray)." PILSBRY, 1893, 14: 271 to 273; plt. 60, figs. 1-6 - NIERSTRASZ, 1905: 148; plt. 10, fig. 18 - PILSBRY & LOWE, 1932: 129 - KEEN, 1958: 522; Amphineura, fig. 30 (with syn. *Chiton bicostatus* Orbigny, 1841) - THORPE in Keen, 1971: 873; Polyplacophora, fig. 30 (with syn. *Chiton bicostatus* Orbigny, 1841; *Callistochiton periconis* Dall, 1908; *C. fisheri* Dall, 1919) - A. G. SMITH & FERREIRA, 1977: 88 [not *Chiton pulchellus* Gray, 1828]
- Callistochiton fisheri* DALL, 1919: 512; 1921: 194 - OLDROYD, 1927: 899 - LAROCQUE, 1953: 12 - THORPE in Keen, 1971: 873 (syn. of *Callistochiton pulchellus*) - ABBOTT, 1974: 399 - A. G. SMITH, 1977: 217, 241 (syn. of *C. pulchellus*)

Nomenclatural Comments: This common Central America species has been referred to as *Chiton pulchellus* Gray, 1828, by authors following C. B. ADAMS (1852), MÖRCH (1861), and PILSBRY (1893). The examination of Gray's type specimens of *Chiton pulchellus* (BMNH 197739) has conclusively demonstrated that Gray's original material, collected at Arica, Chile, is distinctly different from Central American "*pulchellus*."

The first available name for the Central American species is *Callistochiton periconis* Dall, 1908. It is a tribute to Dall that, with the description of *C. periconis*, he was the first author to realize that the Central American species differed from *C. pulchellus* (Gray) in several important particulars. Unfortunately, under the lasting influence of Pilsbry's Manual, Dall's observations were ignored and *C. periconis* relegated to the synonymy of the erroneously called "*pulchellus*." In this respect, it is interesting to note that even LELOUP (1953), having examined Gray's syntypes at the British Museum (Natural History), did not notice the discrepancies involved as he spoke of "this species . . . well described and figured by Pilsbry (*op. cit.*: 19).

Original Description: "Animal small, of a pale brownish color with a narrow dark girdle covered with small, closely packed setose scales; middle valves with the sculpture of *C. pulchellus* (Gray) Pilsbry, from Peru, but differing in the following particulars: the posterior ribs of the middle valves are transversely striated, not nodular, and do not serrate the suture; the anterior valve has thirteen rounded finely cross-striated ribs, the posterior has seven; this valve considerably overhangs the posterior part of the girdle, and the two anterior ribs are conspicuously larger and stronger than the five between them. The gills are prolonged, reaching the second valve. Perico Island, Panama Bay, collected on the reefs by the 'Albatross' party, U. S. N. Mus. 110,763." (DALL, 1908: 355-356).

Expanded Description:

High arched, round backed chitons, up to 1.5 cm in length. Color buff-cream to very dark brown. Anterior valve with 10-13 strong rounded radial ribs, often cut by a vague series of concentric transverse growth lines. Posterior valve elevated, with a mucro markedly posterior; post-mucro area strongly convex with 6-8 rounded radial ribs similar to those in anterior valve. Intermediate valves with elevated lateral areas bearing 2 prominent radial ribs of which the posterior is usually wider, and sculptured with transverse tubercles that, in some specimens, confer a serrated appearance to the sutural spaces. Central areas with longitudinal riblets that become diagonal and criss-cross, particularly in the midline, to form diamond-shaped pits. Girdle covered with strongly imbricating, oval scales, about 120 μm long; although under ordinary magnifications appearing smooth, the surface of the girdle scales, when examined in SEM micrographs, is seen to be covered by minute spherules (often eroded away) on the upper face, and vertical ribs on the lateral faces (Figures 22, 23).

Articulamentum white, often with a bluish tint particularly accentuated in valve viii. Sutural laminae semioval, becoming quadrate in valves vii and viii. Sinus wide and shallow, often minutely notched. Insertion plate cut into strong teeth; in the posterior valve, the insertion plate is not prominent (the teeth tending to point away from the midline) and exhibits minute denticulations, irregularly disposed, inwardly. The massive thickness of the posterior valve makes its insertion plate, particularly in large specimens, less than conspicuous. The insertion teeth are often thickened at the edges and festooned, corresponding in position and number to the ribs of the tegmentum, except in larger specimens where often the number of teeth exceeds the number of tegmental ribs. In one of the specimens examined (AJF 218, Mensabé,

Panama, *leg.*, A. J. Ferreira, 12 February 1978, intertidal), 12.5 mm long, the slit formula is 10-1-11.

The radula of this specimen is 3.8 mm long (30% of the specimen's length), and comprises about 80 rows of mature teeth. The median tooth is slightly enlarged anteriorly where it bears a small blade, and measures about 28 μm in width; from there it narrows slightly posteriorly, and then enlarges again to a width of about 30 μm . In length, the tooth measures about 65 μm . The first lateral teeth are subquadrate, about 80 μm long, 25 μm wide; they bear a small blade anteriorly. The second (major) lateral teeth have a long, bicuspid head; the outer cusp, the longer and larger, is about 80 μm long and 25 μm wide, while the inner cusp is much shorter and inconspicuous. The outer marginal teeth are squarish, measuring about 50 μm in length and in width. The radula of *Callistochiton periconis* is figured here for the first time (Figure 24).

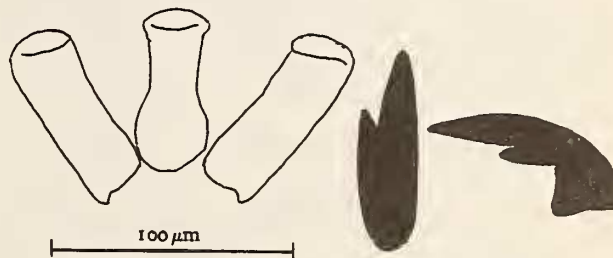


Figure 24

Callistochiton periconis Dall, 1908

Radula: Median tooth, first lateral teeth, and heads (dorsal and profile views) of second lateral teeth. Specimen collected at Mensabé, Panama (AJF 218), original length 12.5 mm

Type Material: Holotype (USNM 110763); color slide, photograph of the specimen taken by A. G. Smith, at CASIZ Color Slide Series no. 1927.

Callistochiton fisheri Dall, 1919: 6 syntypes (USNM 110353); color photograph of 4 of the specimens taken by A. G. Smith, at CASIZ Color Slide Series no. 1933.

Type Locality: Perico Island [8°55'N, 79°31'W], Panama Bay, Panama.

Distribution: The range of *Callistochiton periconis* is relatively narrow, extending only between parallels 11°N and 6°N. The northernmost record of the species is a small bay at "Hacienda Nacascolo," 2 km N of San Juan del Sur (11°15'N, 85°52'W), Nicaragua (AJF 138, *leg.*,

A. J. & N. J. Ferreira, low intertidal zone, 26 January 1974). The southernmost record is Punta Cruces ($6^{\circ}40'N$, $77^{\circ}33'W$), Colombia (CASIZ 006297, *leg.*, D. P. Abbott, *Te Vega* Cruise 18, sta. JT-20, intertidal, 2 May 1968), with many stations in between. The bathymetric range extends from the intertidal zone to 30 fathoms [55 m] (AJF Collection, Bahía Santa Elena, Costa Rica, R/V *Searcher*, Sta. 391 trawling, *leg.* A. J. Ferreira, February 1972). The largest specimen of *C. periconis* examined is 14.5 mm long, including girdle (ANSP 243632, reef at San Francisco, near Panama [City], *leg.*, Pillsbury, 17 May 1929).

Remarks: The placing of *Callistochiton fisheri* in the synonymy of *C. periconis* is based upon the observations of A. G. SMITH (1977) who examined and photographed the 6 specimens in the syntype series. The study of the color slides of 4 of the syntypes shows conclusively that *C. fisheri* and *C. periconis* are conspecific. As pointed out by A. G. SMITH (*op. cit.*: 241), the statement that *C. fisheri* had been collected in the Aleutian Islands must be considered as erroneous.

Callistochiton pulchellus (Gray, 1828)

(Figures 25, 26)

- Chiton pulchellus* GRAY, 1828: 6 (reference is made to plt. 3, fig. 9, never published but on file at BM[NH], *teste* A. Blake, in *litt.* 28 November, 1977) [not *Chiton pulchellus* Philippi, 1844] - REEVE, 1847: sp. 153, plt. 23, fig. 153 - PAETEL, 1873: 80
- Callochiton pulchellus*. H. & A. ADAMS, 1858: 471
- Callistochiton pulchellus*. DALL, 1909: 246 - BOUDET, 1945: 134 - LELOUP, 1953: 18-19; fig. 3 [misinterpreted]; 1956: 46 - STUARDO, 1959: 144, 146
- [Not *Callistochiton pulchellus ex auctore* treating Panamic specimens]
- Chiton bicostatus* ORBIGNY, 1841: 486; plt. 81; figs. 7-9; 1854: 54
- Callistochiton carmenae* A. G. SMITH & FERREIRA, 1977: 87 to 88; figs. 10-11
- Callistochiton shuttleworthianus* Pillsbury. BERGENHAYN, 1936: 284-285; text figs. 3f-3g - KAAS, 1972: 100-101 - GÖTTING, 1973: 253 [not *C. shuttleworthianus* Pillsbury, 1893]

Original Description: "6. *Chiton pulchellus*, n. — *Tes-tá oblongá, elongatá, subcarinatá, albido-lutescente; areá centrali puntulatá, laterali costis duobus latis, rugulosis; valvis terminalibus inaequaliter radiatim costatis*. Icon. t. 3.f.9. Inhab. Arica, Peru, Rev. W. Hennah. Brit. Mus. Shell oblong, elongate, slightly keeled, yellowish white; end valves distantly unequally radiately ribbed; lateral

area of the middle valves with two broad regular ribs; central area closely and deeply punctured. Margin yellowish white, with very minute bran-like scales. The ribs of the lateral areas are rarely bifid. Length $\frac{3}{8}$, breadth $\frac{1}{6}$ of an inch." (GRAY, 1828: 6).

As mentioned before, plate 3 of *Spicilegia Zoologica* was not published. However, thanks to the generosity of Aileen Blake, Mollusca Section, Department of Zoology, British Museum (Natural History), I was able to study a xerox copy of that unpublished plate in the repository of the British Museum, and verified figure 9 as corresponding to Gray's description, above as well as to the syntype series (BMNH 197739).

Detail figure of the posterior valves is given by REEVE (1847: sp. no. 153). Both Gray's figure and Reeve's enlarged detail are reproduced by PILSBRY (1893) in plt. 60 as figs. 1 and 2, respectively.

Description: The type material (BMNH 197739) was examined on a loan secured through the kindness of Aileen Blake (BMNH), October 1977. The vial contains a single label which reads: "British Museum (Natural History) / *Chiton pulchellus* Gray / Syntypes / Reg. No. 197739 / 3 specs." An invoice accompanying the specimens states further, "Arica, Peru, Rev. Hennah."

The syntype series consists of 3 specimens, dry, flat, in fairly good condition; they show vestiges of glue and paper to which they were probably attached in the past. All 3 specimens are a uniform tan color, and show a diffuse black smudge along the jugum, obviously externally acquired. The specimens measure, including the girdle, 8.7×5.3 mm; 8.4×5.0 mm; and 6.6×3.5 mm. The largest specimen (Figure 25) here designated as lectotype, shows about 15 radial rows in the anterior valve; these ribs are very low in profile. The posterior valve has a central mucro, low, but slightly pointed; the post-mucro area is flat to slightly concave, showing some 11 radial ribs, low and weakly defined. The intermediate valves are subcarinated. The lateral areas are well defined; they bear 2 relatively flat radial ribs, the posterior rib weakly but definitely crenulated. The central areas are pitted; the pits are mostly round, and become much less accentuated, almost obsolete at the jugum. The girdle is covered with very small, seemingly striated scales. The 2 paralectotypes, although smaller in size, have virtually the same characteristic as the lectotype.

Among the chiton material collected in Chile by Dr. James H. McLean, 1975, 2 lots of *Callistochiton pulchellus* (Gray, 1828) were recognized. One (LACM 75-10) consists of 26 specimens, preserved in alcohol, bearing the locality label "Intertidal, Pozo Toyo (S of Iquique), Tarapaca Prov., Chile ($20^{\circ}25'S$, $70^{\circ}10.5'W$), *leg.* J. H.